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10 April 1956

MEMORANDUM FOR: Project Director

THROUGH: Contracting Officer

SUBJECT: Abstract of Baird Associates Report on "Solar and Celestial Navigation" Volumes I and II

1. Introduction:

a. This report has been prepared as part of the study phase of the AQUATONE contract with Baird. It is dated 25 February 1956 and covers work up to that date.

b. Volume I is a summary of work directly related to AQUATONE requirements. While it is unclassified, it is intended specifically for Project distribution.

c. Volume II is a compilation of work done at Baird which was less directly related to AQUATONE and more general in scope. It contains technical reports and studies on various phases of research in the navigational field. It is classified SECRET because of the inclusion of a report on a study performed under contract AF33 (616) - 257h. It is designed for general distribution to interested parties throughout the "navigation community."

2. Volume I.

A. Chronological summary of AQUATONE work at Baird Associates.

(1) Investigation of the James Baker proposal for a navigation system based on photographic comparison of solar detail resulted in the recommendation that such a system, while feasible in a technical sense, was beyond the capabilities of the present state of the art due to time limitations imposed by the Project.

(2) Baird submitted a five-fold approach to the problem for Project evaluation:

(a) Manually controlled sextant using the periscope for presentation.

(b) Manually operated solar detail matching device.

(c) Automatic solar detail matching device.

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(d) Manually operated star clock sextant.

(e) Automatic star clock sextant.

Proposal (a) was determined to be most desirable from the standpoint of time, pilot action, power requirements, and reliability. Proposals (b) and (c) were discarded as being beyond the scope of the Project and (d) and (e) were defered pending further investigation of daytime star visibility from 40,000 feet.

b. Actual design considerations for the manual sextant are discussed in some detail. Particular attention is given to:

(1) Presentation.

(2) Aircraft Installation.

(3) Derotation.

(4) Averaging.

(5) True heading indication.

c. The final section deals with proposed future improvements in the celestial navigation system. These fall into two categories: increased capability and automization to relieve the pilot of manual and mental efforts. The former improvement can be fulfilled by a device which gives a fix rather than a line of position during the daytime. Such a device would be a star clock sextant capable of viewing stars in the daylight from 40,000 feet. While the optics for such a system become quite cumbersome, it is not out of the realm of possibility. Actual confirmation of the ability to view stars under operating conditions will be necessary before this approach is pursued any further. The automization feature can best be incorporated into a star tracking device similar to the Kollsman photo-electric sextant.

3. Volume II.

a. Recording of solar detail is discussed with particular attention given to the filter requirements and experiments in solar photography.

b. The problems encountered in matching solar or lunar photographs with a rotational displacement are reviewed. The conclusion drawn is that accuracies of the order of $\frac{1}{4}^{0}$ are possible.